

U.S. Patent Application Serial No. **10/049,615**
Amendment dated August 12, 2003
Reply to OA of **March 20, 2003**

REMARKS

Claims 1-4 are pending in this application. Reconsideration of the rejections in view of these amendments and the following remarks is respectfully requested.

Claim Objections

Claim 3 stands objected to because of informalities.

Claim 3 has been amended to correct the informalities.

Rejections under 35 USC §112, Second Paragraph

Claim 1 stands rejected under 35 USC §112, second paragraph, as being indefinite due to the recitation “a transition metal element consisting of Mn.” Claim 2 also stands rejected under 35 USC §112, second paragraph, as being indefinite due to the recitation “a transition metal element consisting of Mn.”

Accordingly, claims 1 and 2 have been amended to change “a transition metal element consisting of Mn” to --manganese--.

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Double Patenting

Claims 1 and 2 stand provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-9 of copending Application No. 09/696,013. Claim 3 stands provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-9 of copending Application No. 09/696,013 in view of Schezina (U.S. Patent No. 5,679,965). Claim 4 stands provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-9 of copending Application No. 09/696,013 in view of Schezina and Yamamoto et al (*Solution Using a Codoping Method to Unipolarity for the Fabrication of p-type ZnO*).

Applicants respectfully traverse this rejection.

Amended claim 1 recites "A ferromagnetic p-type single-crystal zinc oxide material including manganese and a p-type dopant."

Zinc oxide is known as a photoconductive semiconductor material. Ferromagnetic zinc oxide material was not known. Application No. 09/696,013 is based on discovery that about 50% of zinc can be substituted by transition metals of Ti, V, Cr, Fe, Co, Ni, Rh, Ru, which have ion diameters similar to that of zinc, resulting in ferromagnetism without changing the single crystalline structure. Unlike these transition

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metals, when manganese is doped into zinc oxide, it exhibits antiferromagnetism (see Fig. 2 of Application No. 09/696,013).

Although Application No. 09/696,013 mentions adding an element selected from Ti, Mn and Cu in addition to adding transition metal, this is for controlling the ferromagnetism. For example, Fig. 4 of Application No. 09/696,013 shows that ferromagnetism is controlled by adding manganese to zinc oxide which was made ferromagnetic by adding Fe as the transition metal.

As already discussed, when manganese is simply doped into zinc oxide, it exhibits antiferromagnetism but not ferromagnetism. In the present invention, counteractive holes, i.e. p-type dopants, are doped at a high concentration in order to make the spin of manganese into ferromagnetic. The p-type dopants are one or more selected from C, N, or oxides of these. The present invention uses manganese, which is a peculiar element for ferromagnetism of zinc oxide to obtain a novel material with ferromagnetism, which was not disclosed in Application No. 09/696,013.

Thus, Application No. 09/696,013 does not teach or suggest "A ferromagnetic p-type single-crystal zinc oxide material including manganese and a p-type dopant."

For at least these reasons, claim 1 patentably distinguishes over Application No. 09/696,013.

Schezina and Yamamoto et al have been cited for allegedly disclosing the recitations in claim 3 or

4. Such disclosures, however do not remedy the deficiencies of Application No. 09/696,013.

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Therefore, claims 3 and 4, directly or indirectly depending from claim 1, also patentably distinguish over Application No. 09/696,013, Schezina and Yamamoto et al.

Thus, the obviousness-type double patenting rejections should be withdrawn.

Rejections under 35 USC §102(b)

Claim 1 stands rejected under 35 USC §102(b) as being anticipated by Yoon et al. (U.S. Patent No. 5,368,764), and claim 1 also was rejected under 35 USC §102(b) as being anticipated by Nishiyama et al. (U.S. Patent No. 4,174,421). In so doing, the Examiner alleged that Ca, V, and Cu are well-known p-type dopants for ZnO.

Applicants respectfully traverse this rejection.

Claim 1 recites “A ferromagnetic p-type single-crystal zinc oxide material including manganese and a p-type dopant.”

Yoon et al. and Nishiyama et al. does not discuss the type of dopants. Also, Ca, V, and Cu are not p-type dopants for ZnO.

As shown in the present specification, C (Group IV element) and N (Group V element) are p-type dopants and B, Al, In, Ga (Group III elements), Zn (Group II element) and H (Group I element) are n-type dopants. The classification of n-type dopants and p-type dopants is different from that of semiconductor such as Si.

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Thus, Ca and V are not well-known p-type dopants for ZnO despite the Examiner's allegation. The Examiner is requested to provide the evidence for the allegation that Ca and V are well-known p-type dopants for ZnO.

Thus, the 35 U.S.C. §102(b) rejections should be withdrawn.

Rejections under 35 USC §103(a)

Claim 2 stands rejected under 35 U.S.C. §103(a) as being obvious over Yoon et al. or Nishiyama et al. in view of Yamamoto et al.; Claim 3 was rejected under 35 U.S.C. §103(a) as being obvious over Yoon et al. or Nishiyama et al. in view of Schetzina; Claim 4 was rejected under 35 U.S.C. §103(a) as being obvious over Yoon et al. or Nishiyama et al. in view of Schetzina, and further in view of Yamamoto et al.

Applicants respectfully traverse these rejections.

Claim 2 recites "A ferromagnetic p-type single-crystal zinc oxide material including manganese, a p-type dopant, and an n-type dopant."

As already discussed "A ferromagnetic p-type single-crystal zinc oxide material including manganese and a p-type dopant," as recited in claim 1, patentably distinguishes over Yoon et al. and Nishiyama et al. Yamamoto et al. was cited for allegedly disclosing codoping ZnO with p-type dopant and

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n-type dopants. Such disclosure, however, does not remedy the deficiencies of Yoon et al and Nishiyama et al. Therefore, claim 2 also patentably distinguishes over Yoon et al for at least the same reasons.

Schetzina was cited for allegedly disclosing MBE source for molecular zinc of zinc metal and an oxygen plasma source and additional source ports can be added to the system for MBE deposition of other materials. Such disclosure, however, does not remedy the deficiencies of Yoon et al and Nishiyama et al. Therefore, claims 3 and 4, depending from claim 1, also patentably distinguish over Yoon et al for at least the same reasons.

Thus, the 35 U.S.C. §103(a) rejections should be withdrawn.

In view of the aforementioned amendments and accompanying remarks, claims, as amended, are in condition for allowance, which action, at an early date, is requested.

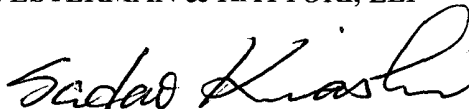
If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

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In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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